Report of Proceedings

RESEARCH CONFERENCE ON DECIDUOUS FRUITS

October 28 and 29, 1958

Conference was held at the Eastern Utilization Research and Development Division with representatives from industry, the State Agricultural Experiment Stations, universities, fruit producers and processors, and the U. S. Department of Agriculture and other Federal agencies participating.

This report summarizes the discussions of the various speakers during the conference. If further details regarding any particular subject are desired they may be obtained by communicating with the person concerned (see appended list of names and addresses).

Eastern Utilization Research and Development Division
Agricultural Research Service
U. S. Department of Agriculture
Philadelphia 18, Pennsylvania

PROGRAM

Tuesday, October 28

9:40 a.m.	Introductory Remarks	P. A. Wells Eastern Utilization Research and Development Division
9:45 a.m.	The Effect of Orchard Sprays on Fruit Quality	J. D. Moore Agricultural Experiment Station Madison, Wisconsin
10:35 a.m.	Bulk Handling of Fruit	J. H. Levin Agricultural Research Service, U.S.D.A. East Lansing, Michigan
11:25 a.m.	Controlled Atmosphere Storage of Fruit	R. M. Smock Agricultural Experiment Station Ithaca, New York
12:15 p.m.	LUNCH	
2:00 p.m.	Raw and Processed Grades of Sour Cherries	J. C. Moyer Agricultural Experiment Station Geneva, New York

3:00 - 5:00 p.m. Tour of Laboratory

Wednesday, October 29

9:00 a.m.	Grades for Apples for Processing	A. Lopez Agricultural Experiment Station Blacksburg, Virginia
10:00 a.m.	Influence of Apple Variety, Maturity and Storage on the Quality of Canned Slices	R. C. Wiley Agricultural Experiment Station College Park, Maryland
11:00 a.m.	Research Problems in Fruit Processing	W. E. McIntosh William E. McIntosh Company, Inc. Geneva, New York
12:00 Noon	LUNCH	
2:00 p.m.	A Continuous Process for Fruit Powders	V. A. Turkot Eastern Utilization Research and Development Division

Wednesday, October 29 (Continued)

3:00 p.m.	Purees from Eastern Freestone Peaches	D. E. Wilson Agricultural Experiment Station Geneva, New York
4:00 p.m.	Time-Temperature Tolerance of Frozen Fruits	W. F. Talburt Western Utilization Research and Development Division Albany, California
5:00 p.m.	Adjournment	

INTRODUCTORY REMARKS

by

P. A. Wells
Eastern Utilization Research and Development Division

Dr. Wells pointed out that the present conference represents the annual conference for the State Experiment Station Collaborators of the Eastern area. The subject for the conference, Deciduous Fruits, was selected by the Northeastern Experiment Station Directors at their meeting held in the early part of the present calendar year, and appointment of collaborators was made by the Directors with this meeting in mind. However, collaborators not wishing to attend the present meeting can come here at any time during the fiscal year for conferences with our staff. In addition to the Experiment Station people, representatives from universities, other government agencies, producers, processors and other industry representatives were invited to attend.

A report of the present conference will be prepared and each person attending will receive a copy. Extra copies will be supplied on request.

THE EFFECT OF ORCHARD SPRAYS ON FRUIT QUALITY

by

J. D. Moore, Agricultural Experiment Station
Madison, Wisconsin

The present Wisconsin studies on the effects of orchard sprays on the quality of fresh and processed deciduous fruits were started in 1949. Originally the work was limited to a study of the effects of fungicides on sour cherries, and data on fruit size, fruit color, soluble solids, drained weight, and can corrosion were obtained. A report of this earlier work was presented at the Conference on Red Sour Cherries held in March, 1955.

Since 1955 our program has been expanded to include work with insecticides and has been carried out under a cooperative project involving the Departments of Dairy and Food Industries, Entomology, and Plant Pathology of the Wisconsin Station.

The scope of the operation was correspondingly increased, and in addition to the types of data taken in the earlier work, results are now being obtained on pit weights, weight losses in pitting, titratable acidity, pH, and flavor. Firmness and texture are also under study, but no satisfactory methods have been devised for obtaining quantitative measurements of these factors.

In all of the can corrosion studies since 1950, the experiments have been conducted in cooperation with the Central Research Division of the American Can Company, and all canning has been done in cans prepared each year from uniform tin plate especially for this work but treated in the usual manner with the standard enamel used for cans for RSP cherries.

Apple studies have been in progress only since 1957, and no conclusive data on this work are available at this time. Furthermore the results with the

insecticides studied have not been very consistent and will not be discussed here.

Since time will not permit a full discussion of the results with fresh, frozen, and canned cherries, I have chosen to illustrate this presentation primarily with data obtained from cherries harvested in 1956. In general, these results confirm the general conclusions drawn from work carried out in previous years, which may be summarized as follows:

Cherries sprayed with Bordeaux mixture have been the smallest in size, have had the lowest can vacuum losses on storage, the highest drained weights, the highest percent soluble and total solids, and have been among the highest in titratable acid. In most years their flavor was preferred by the taste panels to that of fruits sprayed with any other treatment. Bordeaux sprayed cherries have had very poor color, especially when canned.

Cherries sprayed with dithiocarbamates (ferbam, nabam) have been the largest in size, have had the greatest can vacuum losses, low drained weights, low percent soluble and total solids, low titratable acid, and have received low preference ratings in the flavor work. Can corrosion studies have indicated a reduction in "can life" from the use of dithiocarbamates of about 20 percent.

Cherries sprayed with a complete schedule of Actidione alone at 2 p.p.m. have been small in size and usually have had the lowest pH and the best color. In some years a bitter flavor has been associated with the use of this schedule. With a mixed schedule of Actidione at 1 p.p.m. with ferbam, fruit size has been almost as large as with ferbam alone, fruit color has been almost as good as with Actidione alone, and in most years the flavor has been very good.

The results with a mixed schedule of one application of Bordeaux mixture and two or three of ferbam before harvest have been intermediate between those obtained with straight Bordeaux and straight dithiocarbamate with respect to most quality factors studied.

In the Wisconsin program it is now the established policy to make certain that spray chemicals and schedules will not have a harmful effect on the various factors of fruit quality before they are recommended to the fruit growers.

BULK HANDLING OF FRUIT

by
Jordan H. Levin, Agricultural Research Service
U. S. Department of Agriculture, East Lansing, Michigan

The production of fruit for the American public involves not only the growing of the fruit but the harvesting and handling as well. Harvesting and handling are important phases not only because they are costly operations involving the most labor, but also because quality can be seriously affected. The Agricultural Engineering Research Division, Agricultural Research Service, U. S. Department of Agriculture, in cooperation with Michigan State University and other land grant colleges, has been conducting research to improve the efficiency of harvesting and handling.

For years fruit has been handled in containers holding 25 to 100 pounds. The containers protect the fruit from some mechanical injury and make manual handling possible. Piece-by-piece handling requires many workers, who not only are becoming increasingly hard to find, but who charge more and more for their services.

Research has shown that handling a number of containers at one time as a unit load on a pallet with a fork lift truck reduces the labor costs. However, fruit is still handled in small containers costing 50¢ to $1.00 each, and thousands are needed. They are easily broken and many are lost each year. It is estimated their average life is about five years. Not only is the annual cost of providing the millions of containers high, but accounting, proper distribution and storage are major management problems. Where bulk methods of handling can be used they save time, money and labor. As a result of research, semi-bulk methods for handling many fruits have been developed and adapted by fruit growers.

Bulk boxes, also called bulk bins, pallet boxes or bins, tote boxes, etc., are being used to handle apples, pears and peaches. A bulk box is essentially a combination pallet and box holding 16 to 25 or more bushels. The pallet forms the floor of the box and is an integral part of the unit.

Bulk boxes are distributed in the orchard. When a picker's bucket is full, he walks to the nearest box, leans against its side, and allows the fruit to flow into the large container. Pickers like the large boxes because they are easy to fill, facilitate keeping account of the number of bushels picked, and the pickers need not spend time moving and leveling off the small bushel crates.

The filled boxes are moved by tractor lift equipment from the field directly to the orchard dock, storage or packing house. In some cases where the distance is over 3/4 mile, the filled boxes are placed on orchard trailers for movement out of the orchard. Since the filled boxes weigh over 1,000 pounds they can only be handled by lift equipment. Today, orchard lifts are available, and in Michigan almost every commercial fruit orchard has some type of fork lift equipment.

Lift attachments can be mounted on three-point hydraulic hitches, bolted on hay rakes, or mounted on either rear or the front end of the tractor. Tractor units can be purchased with steering and gear shift reversed. Some growers even make their own units from an old truck chassis by adding a lift mask to the drive end. See ARS 42-20 (August 1958) "Equipment Used by Deciduous Fruit Growers in Handling Bulk Boxes" for detailed discussion of fork lift equipment.

At the orchard yard the filled boxes are usually handled with industrial lift equipment and either loaded on out-going trucks or put into storage.

One of the problems encountered was to find a method of emptying the bulk boxes without bruising the fruit. During the 1956-57 packing season, a relatively inexpensive mechanical dumper that caused less bruising than the field crate handling method was developed and tested by Agricultural Engineering Research Division personnel. Over one hundred and twenty-five of the units are now in use. The machine consists of a pivoted bulk box "holder"

supported by a rigid frame so that a filled box placed upon it can be raised into dumping position by means of hydraulic cylinders. The action of the cylinders is controlled by a three-way valve. As the filled box swings up into dumping position, it comes in contact with a padded cover, a part of which is hinged to allow space for the passage of fruit. During the dumping operation, the movement of this portion of the cover can be regulated by the operator in such a way that the fruit flows out with a minimum amount of bruising.

Dumpers which turn the box upside down and lift it off the fruit have been developed and are in use in the West. However, they cost five or six times as much as the first dumper described.

The advantages of bulk handling of apples are many. A USDA-Michigan State University study showed that the saving is approximately thirteen cents per bushel handled. However, even more important, most of the growers feel that the reduction in the amount of bruising is the most outstanding advantage. Possible reasons for less bruising is the 2/3 less wood surface per bushel of apples in the bulk box as compared with the bushel crate and reduced jarring and easier handling of the big boxes.

Although this method of handling is in its infancy, over 40% of the Michigan crop was handled in bulk boxes this year. More than 125,000 boxes were used to handle approximately 4,000,000 bushels of apples for fresh market in the Wenatchee and Yakima areas of Washington in the last few months. Growers in other areas such as Pennsylvania, New York, Maryland, etc., are also using bulk boxes.

In handling tart cherries bulk methods have been achieved by replacing the wooden lugs with either portable tanks or tank trucks containing water. In some cases the cherries are picked in pails and moved to an orchard dock. There they are poured directly into cold water in a tank truck. At the processing plant the truck driver unloads the fruit by simply opening the valves. In other cases 4' x 4' x 4' metal tanks which can be handled with orchard lift equipment are placed in the orchard. The cherries are placed in the cold water in these tanks by pickers. When a tank is full it is moved onto a trailer by a tractor lift and transported to the processing plant. There it is easily emptied again by opening the valve.

Operators who are careful to cool the fruit quickly (using ice water or circulating cold water) and lower the water level to a point a few inches below the top level of the cherries before the truck is moved, find that this method of operation (1) helps maintain on-the-tree quality; (2) eliminates lug storage, maintenance, delivery and accounting problems; and (3) simplifies management.

Cherries are being handled in water to some extent in all major producing areas. Handling peaches in water is being tried in California, and research in Michigan has shown that handling blackberries and plums in water is feasible.

Bulk methods of handling fruit are not only important because they save time, money and labor but may also make it possible to develop more efficient harvest methods. It is felt that any mechanized harvesting method will have to

be combined with bulk handling to obtain the greatest benefits. The Agricultural Engineering Research Division, in cooperation with several land grant colleges, is continuing research in an effort to further develop bulk handling methods for other fruit crops.

References

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CONTROLLED ATMOSPHERE STORAGE OF FRUIT

by
R. M. Smock, Agricultural Experiment Station
Ithaca, New York

Controlled atmosphere storage refers to storage in low oxygen-relatively high carbon atmospheres in refrigerated rooms. It is useful on many varieties of apples and pears but does not work with certain varieties.

This procedure was developed in England in the early 1930's. It has developed commercially in this country slowly but continually until over three million boxes of apples are now stored in this way. Most of this volume is stored in New York, New England, Michigan and California. Commercial trials on pears are now well under way in Oregon and California.

The principal purpose of CA storage is longer storage life and thus extension of the marketing season. The shelf life of CA apples is longer than that from ordinary storage. Low temperature disorders in apples can be avoided with CA storage.

CA storage requires gas-tight rooms that are expensive to build. Operating costs are higher with CA storage. Careful operation is urgent lest serious losses occur from low oxygen damage.

RAW AND PROCESSED GRADES OF SOUR CHERRIES

by
R. L. LaBelle, J. C. Moyer and D. B. Hand (1)
Agricultural Experiment Station, Geneva, New York

The quality of raw material received at canning factories has improved over a period of years and this is due in large measure to the use of U. S. Standards in purchasing fruits and vegetables. The use of these grades has provided an incentive for the production of better raw material and made the delivery of overripe, underripe, undersized or decayed produce unprofitable.

The needs for standards of quality as a means of determining the fair price for a given quantity of agricultural produce was recognized long ago and some states established grades and inspection services. However, the growth of interstate commerce brought difficulties in correlating grades. To overcome these hindrances to trade, Congress in 1917 passed Public Law No. 40: "The Food Production Act to Provide Further for the National Security and Defense by Stimulating Agriculture and Facilitating the Distribution of Agricultural Products" which empowered the Secretary of Agriculture to certify as to the quality of fruits and vegetables for shipment.

In order to apply this operation of grading, it was necessary to develop a set of standards by which the quality of raw fruits and vegetables may be judged. Such standards were evolved by the U. S. Department of Agriculture after consultation with growers and shippers and with regard to prevailing trade practices. The inspection of fruits and vegetables is done by employees of the U. S. Department of Agriculture or cooperatively by a Federal State Agency. Usually the Federal-State cooperative system is employed where the produce is moved over relatively short distances while inspection is made by the Federal employees where the commodity is shipped long distances. In either case, supervision of the grading to maintain a close adherence to the standards is the responsibility of the U. S. Department of Agriculture. This is done by continuous training of the inspectors and by providing their supervisors with models created by artists to show the shape, color and injury limitations of each commodity grade. Unless specified by State regulations, or Federal marketing agreements, the inspection service is voluntary and must be requested by the grower or buyer. This inspection system is sustained by fees levied for this service.

Grades for canned or frozen vegetables have also been established, although their development has usually occurred sometime after the publication of the raw product standards. The standards for their grades are developed by the U. S. Department of Agriculture after consultation with processors and buyers. Inspection of processed foods is performed by employees of the Federal Department of Agriculture. Except when specified in government purchases of food supplies, this service must be requested by the buyer or seller and the inspection fees thus collected are used to make this service as nearly self-sustaining as possible. The grading may be done in regional offices located in the main food processing areas or a packer may apply for continuous inspection in his plant and mark the product with a government shield denoting the grade.

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(1) Presented by J. C. Moyer.

The grade certificates issued by Federal or Federal-State inspectors may be appealed when the buyer or seller believes the assigned grade is unsatisfactory, and a reinspection will be made by the Washington office or a delegated regional office.

Thus, two types of grades have been developed independently over the past 30 years. Approximately 140 grades have been established for fresh fruit and vegetables and more than 100 grades have been promulgated for the processed products. These grades are used to varying extents for the raw or processed material. Some raw grades, such as that for peas, are seldom used while the purchase of canned peas on a graded basis is common practice. In those industries where the raw material is purchased on a graded basis and the price of the processed product is largely determined by grade certificates, questions have been raised concerning the relationship between the raw and processed grades for a particular fruit or vegetable. This is not surprising in view of the fact that the two grades were developed to meet the needs of different groups and the fact that since the first issuance of the grades, much larger percentages of raw fruits and vegetables are being sold to factories rather than the fresh market.

Such a divergence between the raw and processed goods was claimed by New York State cherry processors who stated that high percentages of U. S. No. 1 cherries were downgraded after freezing and canning. It was the consensus that this lack of agreement between the raw and processed grades was more evident when cherries were frozen. To answer the questions concerning this grade relationship in cherries a cooperative study was undertaken by the U. S. Department of Agriculture and the Experiment Station at Geneva.

Three types of studies were carried out to gain information on the grade relationships.

1. Pilot Plant Studies - where commercial processing conditions were simulated on a small scale.

2. Specific Grade Studies - where the raw cherries were individually segregated into several levels of quality before processing by a uniform method.

3. Commercial Studies - where samples were drawn from tanks at freezing plants and frozen at the Experiment Station.

Summary

The results of these three types of studies show that there is no simple relationship between the raw and processed grades for sour cherries. The chief cause of poor agreement between the raw and frozen grades is scald. Major scald observed after soaking had a drastic effect on the score of the final product. There appeared to be a correlation between the amount of major scald found after soaking and the total amount of scalded (major and minor) and bruised fruit noted in the raw product.

Scald may be kept to a minimum by avoiding bruising as much as possible during picking, by eliminating long holding times at high temperatures in the orchard, and by not soaking the cherries for longer than 6 to 8 hours. On

the other hand, intervals shorter than 4 hours between picking and pitting can lead to low character scores because of pitter torn or soft fruit.

Scald adversely affects the color score of frozen cherries and, when it is extensive, also leads to low absence of defects scores. The main cause of downgrading in canned cherries was found to be defects due to blemishes or to severe scald. Minor scald in itself has little effect on canned fruit scores because of pigment diffusion through the flesh during cooking. However, minor scald in conjunction with minor blemishes in the raw fruit can yield lower absence of defects scores in the canned product.

There is evidence that well ripened cherries which might be classified as the best in the U. S. No. 1 raw grade are less susceptible to scald, while No. 1 cherries that have barely enough color for that grade scald more readily. The relationship between grades may then depend on not only the number of poor cherries in a load but also on the quality of the good cherries.

GRADES FOR APPLES FOR PROCESSING

by
Anthony Lopez, Agricultural Experiment Station
Blacksburg, Virginia

The U. S. Standards for Apples for Processing were established in 1930. Since then the standards have remained essentially unchanged. The U. S. D. A. Grades have served the apple processing industry well during a period of great growth. However, the economic conditions in the apple processing industry are at present very different from what they were in the early thirties. Costs of processing apples have increased. Labor in the apple processing industry is today paid about ten times as much as it was in 1930. The changes in the costs of processing apples have emphasized the relative importance of the amount of labor used and the yield of finished products obtained. At present, in order to be able to process apples economically, it is necessary that the fruit be of better quality than was needed some 25 years ago.

In 1954 the Virginia Agricultural Experiment Station inaugurated a research program aimed at gathering data to help establish whether or not the U. S. Standards for Apples for Processing needed to be revised and, if so, the changes that should be recommended. The research project was initiated at the request of the Virginia State Horticultural Society, made up of growers and processors of apples and of other commodities.

In our study on apple processing grades, we were concerned exclusively with the plant operations of peeling and trimming apples, which reflect directly the quality of the fruit, as measured by trimming time, yield of prepared product, and defect trim. The research was done in the apple sauce and in the apple slices canning lines of four Virginia and two Pennsylvania processing plants during four processing seasons. From 7,000 to 30,000 lbs. of apples were experimentally run at each plant. The design of the experimental work was as follows. Fresh apples of the York Imperial variety were

(a) mechanically sized into three sizes, (b) individually graded by Federal-State inspectors into U. S. or Experimental grades, (c) each size-grade lot was weighed, (d) lots were peeled, cored and trimmed (for applesauce), and also sliced (for apple slices), (e) the resulting fractions were weighed, (f) the percent defect trim was determined, and (g) the trimming time was recorded. The sizes used were 2 1/4"-2 1/2", 2 1/2"-2 3/4", and 2 3/4" and up in diameter. The experimental grades are mainly characterized by a maximum allowable defect trim of 3 1/8, 6 1/4, and 12 1/2 percent for the grades A, B, and C, respectively. These experimental grades differ from the U. S. grades in that the maximum allowable defect trim for grades U. S. 1 and U. S. 2 is 5 and 25 percent, respectively. Defect trim does not include peel trim, which results from peel not removed by the semi-automatic peeler. Fifteen experimental lots - five grades in each of three size classes - were run through each plant. The data obtained were statistically analyzed. The statistical methods used are discussed in papers already published and in articles in process of publication.

It was found that the Experimental grades A, B, and C significantly narrow the range of trim waste within a given grade, thus reducing the range of variation in trimming time and yield that can occur in a given grade class. The reduction in trim waste allowance in the top grades from 5% to 3 1/8% reduces the maximum variation in trim time due to effect of trim waste from 10.7 minutes to 6.7 minutes per 100 lbs. of fresh fruit. The maximum variation in yield is reduced from 7.36% to 4.60%. For grades B and C vs. U. S. 2 there is also a large reduction in maximum trim time.

The experimental grades more nearly compensate growers of apples on the basis of the value of the apples to the processor. To comparatively test the effect of the two grade systems on grower returns for apples of different qualities, 38 loads of apples, of approximately 200 bushels per load, coming in to the processors were first sized and then graded by Federal-State fresh fruit inspectors into grades U. S. No. 1, U. S. No. 2, and culls, and then regraded into grades A, B, and C, and culls. Sixteen of the 38 loads were made up of tree run fruit having 75% or more of the apples by weight falling in the U. S. No. 1, size 2 3/4" and up. These were taken as representative of better quality apples (lot I). Fourteen other tree run loads having less than 75% of the apples in grade U. S. No. 1, size 2 3/4" and up, represented lower quality fruit (lot II). Eight loads of drop apples represented poor quality fruit (lot III). All the apples in the three lots were classified on the basis of size and of U. S. and experimental grades, and the percentage of fruit of each size and grade in each of the three lots was determined. A statistical analysis of the data obtained showed that the directional changes in weighted average price, when apples were graded on the basis of the proposed grades, were in a direction that would encourage production of higher quality apples.

Estimating equations for determining differential costs of peeling and trimming apples of different size and quality were developed. These equations were based on trimming time, percent defect trim, and percent yield data experimentally obtained at the commercial plants. The derivation of the equations has been discussed in articles already published. When these equations were applied to prices quoted by a processor in 1955 for U. S. No. 1, size 2 3/4" and up apples, and the relative value of U. S. No. 2 apples present in several truck loads of processing apples was calculated, a negative

value was obtained. This indicates that the apples of U. S. No. 2 quality were of no value to the processor. Results of our work indicate that, in general, U. S. No. 2 apples are of little or no value to processors. With lower quality U. S. No. 2 apples, processors may actually lose by running them through the plant.

We have arrived at a means of determining the prices the processors can afford to pay for apples of a certain quality and size, based on their value to processors. However, we must have more satisfactory methods of determining the actual size and quality of the fruit as it comes to the processing plant. Presently used methods allow for too large a range in sizes of apples within a size classification. A method which would define more exactly the average size of the apples in the load should be devised. It could be based on the number of apples per 100 lbs. of fruit. Samples for quality determinations as taken at present do not reflect well enough the average quality of the entire load. Some means should be developed for making a continuous random sample of the entire load during the unloading process. By taking a relatively large number of small samples, a more representative sample would be obtained.

The Horticultural Societies of Virginia, West Virginia, and Pennsylvania, made up both of growers and of processors of fruit, are in favor of a revision of the U. S. Standards for Apples for Processing in the direction shown by the results of the work outlined here.

Literature References

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2. J. M. Johnson, A. Lopez, and C. B. Wood. Determination of Relative Value of Apples for Applesauce and Evaluation of Experimental Processing Apple Grades. Food Tech. 12, 554 (1958).

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INFLUENCE OF APPLE VARIETY, MATURITY AND STORAGE ON THE QUALITY OF CANNED SLICES (1)

by
Robert C. Wiley and Arthur H. Thompson (2)
University of Maryland, College Park, Maryland

The apples received by processors in the Appalachian area vary tremendously on a day-to-day basis in variety, maturity, and type and duration of storage. Each receipt exhibits a unique set of physical and chemical characteristics which have an important effect on the quality of the manufactured slices. This study involved the six most important commercial apple varieties in this area, and was designed to determine certain physical and chemical characteristics of these varieties, their changes during maturation, their responses to storages of different types and durations, pre-tests for segregation in storage or on the yard, yield and trim data, and the effects of these pre-processing factors on canned product quality.

Results

In both growing seasons, York and Golden Delicious were rated as significantly higher than the other varieties in quality of canned slices. York rated slightly higher than Golden Delicious in wholeness and firmness. Color was the outstanding feature of the Golden Delicious, particularly the brightness factor. In many ways these two varieties are close chemically. Trim losses of these two varieties are close although in weight loss Golden Delicious was highest of all varieties, particularly in common storage.

Jonathan ranked next in quality attributes, being good in wholeness and firmness but lower in color and flavor. Rome and Staymen were consistently rated low in all factors of quality. Northwest Greening in the one season it was processed was significantly lower than the other varieties in all quality attributes.

In storage studies, data showed apples harvested at a pre-optimum stage of maturity made a better processed product if allowed to ripen for about 20 days in common storage and/or 30-60 days in cold storage. Apples harvested at optimum or post-optimum quality levels gave the best quality of processed slices immediately after harvest.

Anhydrogalacturonic acid content of the varieties showed significant differences, with Staymen and N.W. Greening showing the highest amounts. This indicates that a soft variety may have about the same pectin content as a very firm variety. Rome was consistently low in pectic substances but very firm in early harvest and storages.

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(1) This work was done under a research contract with the Eastern Utilization Research and Development Division, Agricultural Research Service, U. S. Department of Agriculture.

(2) Presented by Robert C. Wiley.

Wholeness, firmness, color, and flavor as evaluated by panels accounted for about 96% of the variation in apple slice overall scores. Color accounted for about 45% , wholeness and firmness 50% and flavor 5% on a weighted basis.

Firmness and wholeness in processed apple slices appear to be more closely related to acid soluble pectins than either total or water soluble pectins. There appear to be differences between varieties, with Staymen, York and Jonathan exhibiting significant correlations and Rome and Golden Delicious showing low relationships with acid soluble pectins.

The relationships between the Shear-Press values, a textural measurement, on raw slices and the pectic determinations show a similar pattern. To account completely for the firmness and wholeness differences in apple varieties, it is probably necessary to consider pectins, starches, celluloses, hemicelluloses and lignins together in a multiple relationship.

In pre-testing and receiving-testing it is felt that no one quality test by itself used year after year is sufficient to measure quality of the apple but that the use of several tests in combination shows considerable promise. Nomographs developed from multiple regression equations, including measurements of sugars, acids, firmness, color and others, can be developed for varieties or groups of varieties to predict canned slice quality from raw stock. From properly segregated samples in the yard, process control and finished product quality could be completely standardized.

RESEARCH PROBLEMS IN FRUIT PROCESSING

by
W. E. McIntosh, William E. McIntosh Company, Inc.
Geneva, New York

The research needs of fruit processors are of two general kinds. First, there are many specific problems in food processing which remain to be solved. These include the applications of mechanical equipment, the maintenance of processed quality, etc. Second, there is much to be learned about the nature of fruits, their chemical composition, the changes they undergo during growing, handling and processing, etc., knowledge of which will contribute to better and more efficient processing.

There is a need for better and more frequent communication between research workers and processors. A regularly issued index of publications for distribution to processors would result in keeping them better informed as to progress in fruit research.

Some of the other needs of processors are: Development of a simpler method for use by small packers for determining bacteria and mold counts; studies of comparisons of cold storage vs. common storage of apples; the effect of freezing rate on the quality of apple slices; improved methods for peeling and coring of apples; a method for the continuous sampling of apple sauce to determine sugar addition; an evaluation of compounds for the prevention of oxidation of apple slices; better grading and sampling techniques; more information on harvest timing; studies of mechanical harvesting methods.

A CONTINUOUS PROCESS FOR FRUIT POWDERS

by

V. A. Turkot, Eastern Utilization Research and Development Division

A continuous process for preparing full-flavor powder from fruit juices has been developed at the Eastern Utilization Research and Development Division of the Department's Agricultural Research Service. In the process, the characteristic appealing aroma of the fruit--ordinarily lost in drying--is captured, concentrated, and returned to the dried product.

When mixed with water, the new fruit powders become delicious beverages closely approaching fresh juices in color, flavor and aroma. So far, apple, grape, cherry, strawberry and blueberry powders have been produced in pilot-plant equipment capable of turning out 30 pounds of dried material hourly. The powders are made from pure fruit juices with sugar and, in some cases, fruit acid added. No artificial flavor or color are added. The new powders retain good color and flavor for more than a year of storage at room temperature (72 degrees F.).

Success of the new full-flavor fruit powders was made possible by the earlier development at the Eastern Utilization Research and Development Division of fruit juice "superconcentrates" and "essences." A superconcentrate makes 7 times its own volume of juice when reconstituted with water. An essence is a concentrated water solution containing the volatile aroma portion of a fruit juice, 50 to 1,000 times the aroma strength of the original juice.

To make one of the new powders, nearly all the water in one of the superconcentrates is boiled off in a special evaporator after the addition of sugar and, in some cases, fruit acid. A hot, thick molten residue remains. This is pumped out of the evaporator to a tube where the highly concentrated essence is injected into it and thoroughly mixed under pressure. With the flavor thus fully restored, the sirupy material travels to cold metal rollers which convert it first into a thin sheet and, eventually, into small, brittle flakes. The flakes are coarsely crushed, then sealed in cans ready for use. Each can contains a drying agent which dries the powder still more and prevents caking.

An advantage of fruit powders over single-strength juices is their lighter weight and smaller volume. Their advantage over commercial 3 to 1 frozen concentrates is that they will keep at ordinary room temperature in addition to being lighter and taking up less storage space. When reconstituted with water, the fruit powders taste more like fresh fruit juice than do the juices, like apple juice, that are bottled and pasteurized.

The powders are expected to be useful in military rations. The Quartermaster Food and Container Institute has rated the new dried grape juice very well for flavor. The Quartermaster Corps has already tested compressed wafers containing juice powder as snacks for air crews on long flights. The powders may also be useful as flavoring in dry food mixes for cakes, frostings, ice cream and gelatine. Their possible use in dried whole-milk products is under study. Wafers prepared experimentally by compressing a mixture of dried fruit juice and dried whole milk powder form a nutritious confection with a pleasing flavor.

The process has also been used successfully on a pilot-plant scale to obtain pure dried honey of excellent flavor. It has also been used to dry maple sirup.

Estimates of the costs of producing the dried juice products on a commercial scale have been made. These figures indicate that production of the dried juices would be economically feasible, although the products are not yet in commercial production.

PUREES FROM EASTERN FREESTONE PEACHES

by
D. E. Wilson, Agricultural Experiment Station
Geneva, New York

The effect of harvest maturity, post-harvest ripening and processing on the quality of peach puree was investigated. Halehaven and Elberta varieties were harvested at 2-4 day intervals throughout the 1955, '56 and '58 seasons so that a wide maturity distribution was available. Each fruit was classified as (1) "ripe", (2) "firm ripe", (3) "firm", or (4) "hard" on the basis of U.S.D.A. standards. The "ripe" fruit was processed immediately following harvest and the less mature fruit stored at 70°F. until ripe before processing. It was found that it was necessary to process only fully ripened fruit to obtain the optimum puree color and that the method of ripening was of importance. Purees receiving the highest ratings for color and consistency were obtained from fruit harvested at the "firm" to "hard" stages which required 5 or more days to ripen. With prolonged post-harvest ripening there was a downgrading for flavor, this being especially true for Elbertas stored for periods in excess of 7 days.

Variations of a standard process used in this study could not be directly related to puree quality.

TIME-TEMPERATURE TOLERANCE OF FROZEN FRUITS

by
W. F. Talburt, Western Utilization Research and Development Division
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Frozen foods are truly the "Cinderella" of the food processing industry, having grown from a 0.5 billion pound industry in 1936 to over 9 billion in 1956. Production of frozen fruits and vegetables has increased from 90 million to 2.2 billion pounds in this same period. In spite of this spectacular growth, and perhaps partly because of it, certain rather serious problems of quality retention confront the frozen food industry. As early as 1947, certain far-sighted individuals in the frozen food industry were able to recognize existing problems and foresee future problems that would arise in the handling of highly perishable commodities such as frozen foods. Even in 1947 poor handling practices were already beginning to result in lower quality and many consumer complaints. The past ten years of rapid expansion of the industry have increased the seriousness of the problem.

Variations in temperature are perhaps inevitable in the handling of frozen foods which may require as many as 10 to 20 transfers from one storage or holding location to another before reaching consumers. But how rapidly do frozen foods lose quality under conditions encountered in their commercial distribution and what are the nature of these changes? Do fluctuating temperatures have adverse effects that are not predictable on the basis of temperature alone? Does the sequence of a variable temperature experience have an appreciable effect on rate of deterioration? Are certain varieties of fruits and vegetables more susceptible to deterioration than others? What effects do cultural practices and growing areas have on susceptibility of frozen foods to deteriorative changes when held under adverse storage conditions?

Need for information to provide answers to the above and similar questions prompted representatives of all segments of the frozen food industry to approach the Western Regional Research Laboratory in 1947 and request that a comprehensive research program on frozen foods be set up to provide such information. Requesting this work were representatives of the frozen food packers and distributors, railroad and trucking industries, refrigerated warehousemen, and retail stores.

As a result of this request, comprehensive research was started on frozen fruits in 1950, on frozen vegetables in 1952, and on frozen poultry in 1954. This is now generally referred to as "the time-temperature tolerance" program. In this work over 50,000 individual samples of various frozen foods have been stored under conditions simulating those encountered in the distribution of frozen foods. The research has been eminently successful and, in addition to providing answers to the questions about quality deterioration, has resulted in the development of objective tests for measuring the extent of quality deterioration for many frozen commodities, thus providing the industry with tools for controlling or policing their own operations.

Results of these investigations are now being published in technical journals and are being made available to the industry by displays and discussions at trade association meetings. Initial presentation of the "time-temperature tolerance" results was made in an industry-wide meeting held at WRRL in July 1956. Popular articles are being published in trade association publications and information in popular form is being made available to all segments of the frozen food industry that request it.

Industry interest in the results of this research has been quite remarkable. Objective tests for quality that were developed are already being applied by a number of processors, distributors and large users even though they have been available for only about one year. An industry-wide task group, representing all segments of the frozen food industry, has recently been set up to publicize results of this research and to develop plans for a concerted educational campaign to "tighten up" on handling procedures for frozen foods as a means of improving quality and increasing sales. Thus, the project is proceeding rapidly from a comprehensive accumulation of facts to widespread application by the industry. There is unanimity of opinion that the big job remaining is the training of the tens of thousands of people that handle frozen foods on ways of protecting them from temperature damage. To accomplish this, the entire frozen food industry, trade association publications, utilization research, and the federal and state extension services are cooperating.

Investigations were made using regular commercial retail packs. Of four retail-packed fruits investigated comprehensively, frozen peaches are most quickly and conspicuously damaged. Brown slices can cause consumer complaint, and they may become apparent after total exposures of only one day or even less time at 30°F., 4 to 6 days at 20°F., 60 days at 10°F., or 2 years or longer at 0°F.

Strawberries undergo flavor changes that become easily detectable within 1 to 2 days at 30°F., 6 to 12 days at 20°F., or about 3 months at 10°F.--but will lose only a little top quality in somewhat over a year at 0°F. The discoloration and loss of vitamin C develop simultaneously. Flavor change is early evidence of quality loss. Frozen raspberries reveal temperature damage less quickly than other fruits but tend to lose color from berries to sirup at fairly rapid rates. This change is not accompanied by drastic change in flavor or other quality factors but is useful as an objective test for temperature abuse. Zero or lower temperatures supply adequate protection.

Objective (chemical and physical) tests have been developed which can assist in estimating amount of damage which a frozen fruit has suffered, and consequently provide an indication of the remaining time during which the product can retain suitable quality. One of these tests involves measurement of ascorbic acid and its oxidation products. By using these tests the past storage history of a sample, in terms of time at any given temperature, can be estimated with reasonable accuracy.

Work on retail-sized packages of frozen fruit has been completed and work on bulk packed frozen fruits started.

LIST OF ATTENDANCE

Name	Organization	Address
Ball, C. O.	New Jersey Agric. Expt. Sta.	New Brunswick, N. J.
Baur, P. J.	Tasty Baking Co.	Philadelphia, Pa.
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